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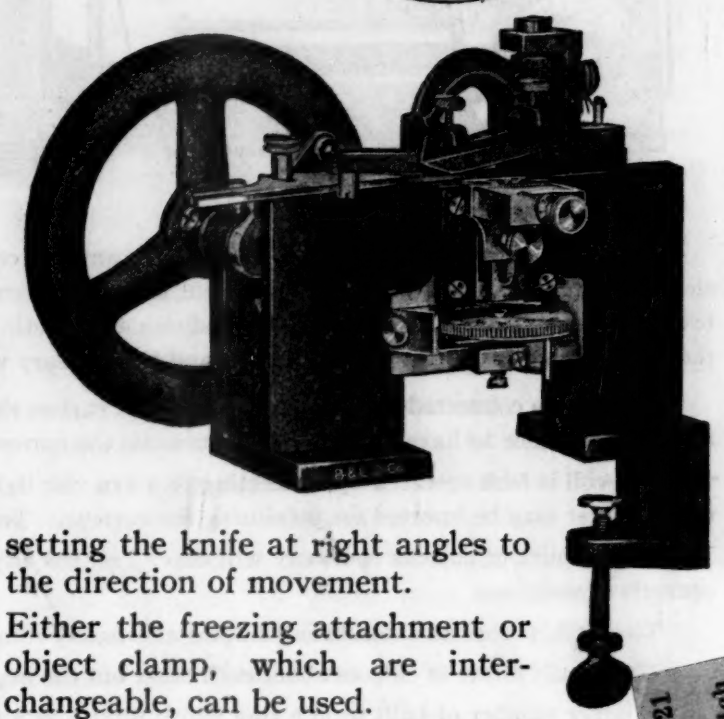

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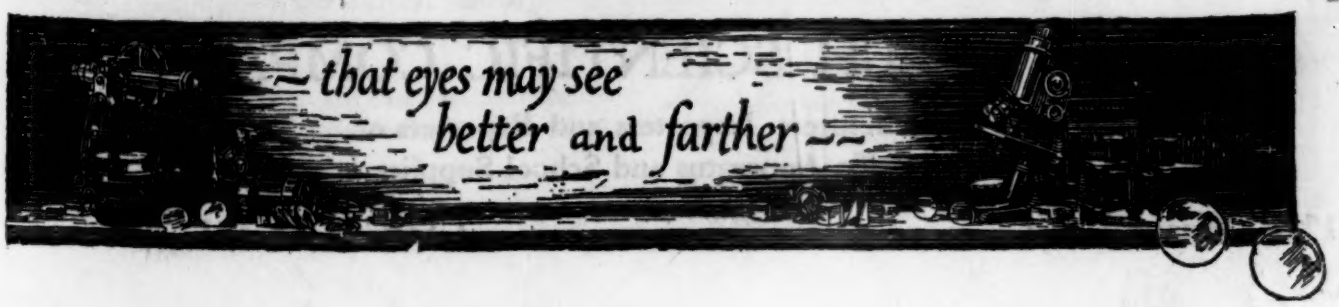

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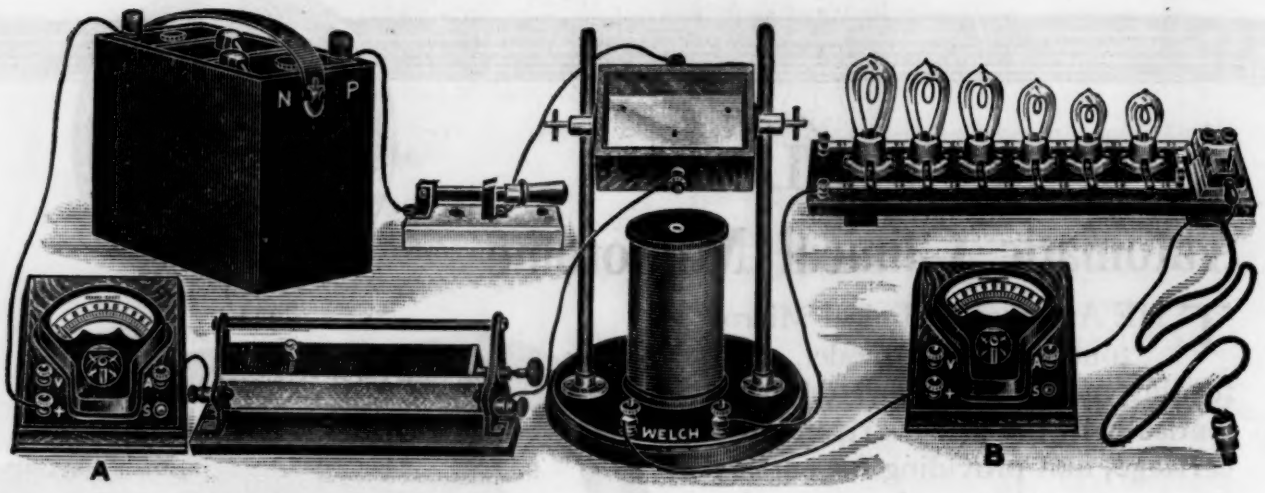
PROF. R. R. RAMSEY, Indiana University, Bloomington, Indiana



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SCIENCE

FRIDAY, NOVEMBER 18, 1921.

CONTENTS

What is the Matter with Physics Teaching?: W. S. FRANKLIN 479
Requirements of a Monograph on the Chemistry of Cellulose: LOUIS E. WISE 482
Eugenics—The American and Norwegian Programs: DR. HENRY FAIRFIELD OSBORN 484
Samuel Stockton Voorhees: DR. W. F. HILLEBRAND 485
Scientific Events: *Synthetic Organic Chemical Manufacturers' Association of the United States; The Editorship of the "Journal of Industrial Chemistry;" Director of the Harvard College Observatory; A Southern Forest Experiment Station; Organization for Research at the Pennsylvania State College; Sigma Xi Lectures at Yale University* 488
Scientific Notes and News 490
University and Educational News 490
Discussion and Correspondence: *Latitude and Vertebræ*: DR. DAVID STARR JORDAN. *Abstracts and Titles of Scientific Articles from the Librarian's Standpoint*: THE LATE EUNICE R. OBERLY. *Longitudinal Electromagnetic Forces*: DR. CARL HERING. *The Scientific Bureaus of the Government*: DR. CHARLES D. WALCOTT 490
Quotations: *Meeting of the American Association in Canada* 493
Scientific Books: *Grabau's Text-book of Geology*: PROFESSOR H. L. FAIRCHILD 494
Special Articles: *A Precision Determination of the Dimensions of the Unit Crystal of Rock Salt*: DR. WHEELER P. DAVEY 497
The American Electrochemical Society: A. D. SPILLMAN 498
The Optical Society of America: DR. IRWIN G. PRIEST 501

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WHAT IS THE MATTER WITH PHYSICS TEACHING?[1]

THE recent appointment by the National Research Council and by the American Physical Society of committees on the teaching of physics shows that our physicists who are primarily interested in research are beginning to see that something is the matter with the college teaching of physics. The question in everyone's mind is "Why the widespread dislike of physics by college students?" As a long-time member of this society I have had much intercourse with engineering teachers, and I have long had in mind an additional question: "Why the widespread contempt of physics teaching among engineering faculties?"

Before giving my answer to those questions I must point out that there is one kind of contempt of physics teaching among engineering teachers which is to the discredit of engineering teachers themselves, namely, the contempt which many of them have for straight and accurate thinking which does not conform to their own careless ways. When I meet with this contempt, which is much too often, I am sorry to say, I always think of a phrase P. G. Tait used in a discussion he gave many years ago of the perennial question of elementary mechanics. "In defense of accuracy," says Tait, "we must be zealous, even unto slaying." It must be conceded that P. G. Tait's ideas concerning elementary mechanics were and are absolutely correct as far as they go, and, after agreeing to use the word weight to designate the pull of the earth on a body, he never reverted to the usage of the grocer and the coal man. This is a thing many of our en-

[1] The opening of a discussion of physics teaching at the Orono meeting of the New England Section of the Society for the Promotion of Engineering Education; autumn, 1921.

gineering teachers do, and it is a thing many of us physics teachers never will do.

Concerning physics teaching, my own opinion is that students dislike physics because they accomplish so little in the study of it in our elementary college courses; and I believe that they accomplish little because the simple, fundamental mathematical ideas and methods which constitute elementary physics are not sufficiently stressed in the class room and not set forth with clearness and brevity in our text-books.

"The instantaneous acceleration of a body is the limit of the ratio $\Delta v/\Delta t$ as Δt approaches zero, where Δv is the change of velocity in time Δt"; but the limit of $\Delta v/\Delta t$ is unthinkable unless one knows the manner in which Δv and Δt approach zero. Advanced students supply this deficiency, as they look backwards at such a definition, by thinking that they think of the so-called principle of continuity! But what is the principle of continuity to a beginner? And what is the beginner to do? The definition of instantaneous acceleration can not be given either logically or intelligibly except in terms of a specific algebraic example where the manner in which Δv and Δt approach zero is clearly evident. I mention this definition of instantaneous acceleration because it is given as stated in nearly every physics text known to me; and yet we ask why students dislike physics. Many physics teachers maintain that it is the business of our mathematics teachers to clear up all mathematical difficulties; but I believe, most decidedly, that the main business of the physics teacher is to cooperate with mathematics teachers in this extremely important matter. I am here considering mathematics largely as a method of thinking, and, surely, if all the difficulties in this method of thinking were cleared up by our mathematics teachers there would be but little left for us physics teachers to do.

Let us consider another example. A fluid at rest pushes normally on an exposed surface, or the exposed surface pushes normally against the fluid. Most of our physics text-books attempt to explain this fact by stating that the shear modulus of a fluid is zero! Or by the following pseudo argument: "If the force exerted on the fluid by an element of the surface were inclined to the surface it would have a component parallel to the surface, and this tangential force would set the fluid in motion; therefore, etc., etc." Now it is absurd to say what this tangential force will do to the small adjacent portion of the fluid without considering the forces exerted on the portion by the surrounding fluid. Many such pseudo arguments may be found in almost any of our physics texts, and I believe they account in large part for the difficulties our mathematics teachers have in the teaching of mathematics. Our physics teachers not only do not help in the important matter of mathematical training but they sometimes hinder this highly important business.

But slovenliness in mathematics is not the only fault in our physics texts. Many a student comes from his boarding house to the class room to hear his physics teacher formalize about position and displacement, although not one of the formalities needs to be used, because the student's already existing knowledge of coming and going is fully sufficient for everything his physics teacher will give him. No wonder that a student never *goes* from the class-room to his study to read about position and displacement in his physics text, even if there should be the grain of a new idea mixed up with the intolerably stupid and immediately purposeless discussion.

A young man from the high school is expected to be edified by the study in college of a physics text which discusses levers of the first, second and third classes, which gives all the old stuff about "simple machines"; and which contains little else that is clear and concise and correct and purposeful!

In the technical school the student is scheduled to study such things as water wheels, and pumps, and engines, and yet he is expected to study a physics text in which all these things are set forth, but no more completely than in his high-school physics

text. This surely is a side-stepping procedure on the part of the physics teacher, because the student's burning need is to be trained in mathematical thinking, and it is absurd to waste time in any descriptive study unless it be with some immediate and attainable analytical end in view.

To illustrate faults of physics teaching by examples chosen from mechanics is comparatively easy; but to illustrate by examples chosen from the equally important subject of electricity and magnetism is very difficult. One reason for this difficulty is, of course, evident; but, in my opinion, the chief reason of the difficulty is that the usual presentation of the elements of electricity and magnetism is so bad as to be beyond the range of intelligible illustration, so bad as to be actually unthinkable! Here is an attempt at an example, and I might attempt a great many as unthinkable as this! Any wheelbarrow pusher may, if he chooses, think that when he stops a wheelbarrow he does not simply stop it, but he imparts to it an "extra velocity" in a backward direction. No one would quarrel with such a wheelbarrow pusher, much as one might be tempted to poke fun at him. But what of the text-book-writing physics teacher who injects into a many-page discussion of self-induction the essentially useless idea of "extra current," and in a way which, when reduced to wheelbarrow language, is exactly equivalent to thinking that he thinks that the "extra velocity" to be imparted to a stopping wheelbarrow is a forward velocity! And yet we ask why students dislike physics.

The above examples of unintelligible halfway mathematics, of fallacious argument, of purposeless formality, of tiresome repetition and of easy side-stepping have been chosen from the subject of mechanics, and the one attempt to illustrate the futilities which ordinarily pass as the *elements* of electricity and magnetism has led us back again to mechanics! Why? Because mechanics is the only branch of physics in which a real beginning has been made in the use of precise ideas by common men.

I know, from experience, that most of our students like physics when the teaching is directed insistently towards the development and use of precise ideas, and I know that the majority of our students can be carried a long way in this difficult but highly profitable business.

But the greatest difficulty in the teaching of physics is to persuade the student to study his text book, and in the face of this difficulty physics teaching has degenerated into interminable class-room coaching, making our teaching not only very exhausting but also frightfully expensive, and greatly weakening the morale of our students. What are we to do about it?

President Hadley made a statement in a brief address before the New Haven Convention of this Society in June, which alone would justify the Convention if it could be taken to heart by our teachers. He said that, although at one time, many years ago, books were used too much, at least, too slavishly, they are now used too little; and the most pressing present need in education work is to place more dependence on books. What are we to do about it?

No one would wish a student to use a book unless he can be led to use it effectively, and the trouble, in physics, at least, is that our text-books can not be used effectively. I am, of course, familiar with what is usually considered to be an effective use of a physics text in our non-exacting college courses in physics which run largely to appreciation-stuff, but I do not consider such use to be effective, most emphatically I do not.

I have discussed college physics teaching with a great many men, and when the discussion has turned to the question of the text book I have always been struck by the tendency of those whom I have known to be the best of teachers to point out the contrast between what they say and do in the class-room and what stands in the text-book. Most of our physics teachers seem to think that a text should be a compendium of all the manifold allusions, suggestions, plausibilities, comparisons, analogies, cross-refer-

ences and explanations which enliven the recitation and lecture and which serve as nothing else can serve to stimulate the student's imagination; but no student can work on such things, and the text-book must be something on which he can work.

The idea is somehow widely prevalent among students, and also among teachers, that the understanding rather than the memory should function in the study of physics; but no one can understand anything until many things are fixed in the mind. The student should be required to burn into his memory all definitions, all statements of principles and laws, all elementary proportions with their proofs and all important equations with their derivations. When he does this he will get a hundred times as much as he can otherwise get from his lectures and recitations, the sum total of his effort will be reduced, and his worry will cease to exist.

The most distressing idolatry the world has ever seen is the modern, popular, science-worship which pays no tithes and takes no pains. It is our Great Religion. Its catechism is science teaching which abhors exactions; its litany is the semi-serious wail of regret of our easier college graduates that a silver-spoon smartness was not transmuted by a pleasant college course into what they conceive the talents of its priesthood to be; and its beatitudes are the above-mentioned appreciation-stuff which imbues every easy-going dilettante with a false sense of understanding the universe and encourages every would-be parasite to think exaltingly that science is the building of steamships to carry him where he has no need to go, of railways to bring him things he could do better without and of airplanes to carry quickly his letters which could not lose in meaning if their time of transit were to take a thousand years!

Most people think of science in terms of its results, chiefly, indeed, in terms of results which facilitate joy riding of all kinds, including easy orgies of near-thinking; but science is Finding Out and Learning How, its great gift to those of us who live inside of its frontiers is an understanding of the things which surround us and of the things we have to do, and its price is pains.

SOME STATEMENTS CONCERNING THE TEACHING OF PHYSICS

Arranged to Promote Discussion at the Orono Meeting of the New England Section of the S. P. E. E.

The teacher must not mistake the fixity of an idea as its *raison d'être.* As relating to ideas fixity and reason are not the same thing, especially when it comes to transmitting ideas to students.

The teacher who mistakes fixity for reason does not, as a rule, exercise himself greatly in his teaching; and the teacher who does put energy into his teaching needs, above all things, to guard against what may be called the "illusion of activity" which is the feeling that one is doing a thing well when one is doing it with all one's might! When a teacher does a lesson with all his might, the students may be doing nothing at all.

It is not the teacher's business to promote the use of the metric system, partly because any effort he may make in this direction is pretty nearly sure to be wasted, and partly because he has too much else to do.

Let the teacher use familiar units wherever possible. In mechanics let him use English units and refer briefly to c.g.s. units. In electricity and magnetism let him use the units of the volt-ampere-ohm system wherever these units can be used, and let him use the electromagnetic c.g.s. units where it is necessary to use them.

Nothing in the teaching of physics is of greater importance than to frame numerical problems so that the data as given might be determined by actual laboratory test. The consistent following of this rule will do much to develop physical sense in the student; and neglect of this rule is sure to leave the student "up in the air."

Ask a student about the effect of an unbalanced force on a body and he is apt to make the

following sounds in answer: *eff equals emm aye!* Do not tolerate the mere reading of an equation in answer to a physical question.

Do not tolerate vague statements. It is physically meaningless to say, for example, that acceleration is gain of velocity divided by time." The proper statement is that the average acceleration *of a body during a given time* is equal to the velocity gained *by the body during the given time* divided by the time. It is meaningless to say that "density is mass divided by volume." The proper statement is that the density of a body is equal to the mass of the body divided by its volume.

Require the student to make every statement of definition, every statement of principle, every explanation of an equation, etc., as relating explicitly to a particular condition or thing.

The natural desire for brevity of statement is often allowed to go much farther than the elimination of the important element of explicitness as above pointed out, and lead to complete obscurity of meaning as illustrated by the following example: A string 10 feet long is tied to a post and a force of 5 "pounds" is exerted on the post by pulling the string. This force certainly "acts through a distance of 10 feet," and, the work done is 50 foot-"pounds" because "work is done when a force acts through a distance." This argument is found to be acceptable to about 60 per cent. of the men beginning a college course in mechanics! No! *Work is done when a body on which a force acts moves in the direction of the force,* and no dictionary ever defined the word *through* in a way to justify the use of the word to abbreviate this 18-word statement as it is usually abbreviated in the study of physics (?) in school and college. Language has been developed as a medium for dickering, quarreling and love-making, and language as used in precise physical specifications is always more or less awkward and more or less strained; but it is a serious mistake to obviate these things by using meaningless expressions and phrases.

I have never talked with an electrical engineer who retained any helpful knowledge or understanding whatever from the study of electrostatics in his college course in physics; and every electrical engineering teacher will tell you that he cannot count on any knowledge or understanding, even incipient knowledge and understanding, of electrostatics among students who have just finished their college course in physics.

WM. S. FRANKLIN
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

REQUIREMENTS OF A MONOGRAPH ON THE CHEMISTRY OF CELLULOSE[1]

IN a seminar devoted exclusively to the chemistry of cellulose certain topical assignments were made to the students, who, after a careful and critical survey of the literature, reported their findings. The course served to emphasize a number of sad facts that are undoubtedly known to all students in the field of cellulose chemistry. We were impressed by the enormous number of undigested, uncorrelated facts that had been amassed apparently as a result of technological studies. We were further impressed by the relatively small number of fundamental studies (bearing the earmarks of painstaking critique on the part of the investigator) that had a direct bearing on the constitution of cellulose, and by the amazing method of presenting these facts in our best English text. It became quite evident as our course proceeded, that there was a lack of vision in the interpretation of noteworthy results in the literature; that little attention had been paid to the methods employed or judgment exercised by investigators in the experimental portions of their work; that scant attention had been given to the correlation of isolated experimental data, and that little differentiation had been made between qualitative and quantitative data in the formulation of hypotheses. To present the case briefly—it became very apparent that a *critical* monograph in the English language was little less than a necessity. Since the close of our seminar, Heuser's new "Lehrbuch der Cellulose Chemie" has appeared, and this splendid work will receive further mention.

A few examples will serve to illustrate the various points previously raised. Take the

[1] Read at the meeting of the American Chemical Society, New York, September 9.

case of the scientific investigations stimulated by the mercerization reaction. Since 1850 (or thereabouts) a number of investigators including Gladstone,[2] Vieweg[3], Thiele,[4] Cross,[5] and others have assigned various formulas to the compound (or compounds) that had been formed between cellulose and sodium hydroxide when concentrated alkali acted upon cotton. The existence of such compounds was disputed by Hubner and Teltscher[6] and later by Leighton.[7] From a hasty review it would appear that the existence of a definite compound between cellulose and sodium hydroxide had never been demonstrated, and that alkali cellulose may perhaps be attributed to adsorption phenomena. Nevertheless, Leighton's work has not affected our interpretation of the constitution of viscose, which presupposes a cellulose alcoholate, ($C_6H_9O_4ONa$ or some similar compound) which then reacts further with CS_2 to form at the outset of the "ripening" process sodium-cellulose-xanthogenate, which gradually hydrolyzes with the loss of NaOH and CS_2 until cellulose is regenerated. It remains possible of course that the xanthogenate reactions given in our texts accurately represent the formation of viscose—and yet, in the light of Leighton's investigations it is disconcerting to note the quiet assurance and certainty with which this explanation of the xanthogenate reaction is generally accepted.

A far more striking example of the lack of critic and indifference with which experimental details are treated in our modern cellulose literature is to be found in the case of the hydrolysis of cellulose to glucose. Our literature has been replete with confident statements that within the limits of experimental error, cellulose is quantitatively hydrolyzed to d-glucose:

$$(C_6H_{10}O_5)_n + nH_2O \rightarrow nC_6H_{12}O_6.$$

Irvine and Soutar,[8] however, have justly shown that this claim has always been made on the grounds of questionable or incomplete experimental evidence, and that in no case was dextrose or a dextrose derivative isolated in any amount approaching the theoretical yield. There is no object in reviewing the work of Flechig,[9] Schwalbe and Schultz,[10] Willstätter and Zechmeister,[11] or Ost and his co-workers.[12] Such a review would either show indirect evidence or incomplete evidence regarding this very fundamental reaction. *It is only within the past year* that Irvine and Soutar themselves[8] have shown that the above equation is substantially correct and that at least 85 per cent. of dextrose is formed when cotton cellulose is hydrolyzed. They failed to account for less than 15 per cent. of the hydrolysis products. Irvine's work is noteworthy in that he isolates his compounds in a state of analytical purity. His experiments are all quantitative and all of his products are definitely identified. The judgment and critique exercised throughout this study are remarkable, and the research must stand as a classical one. It presents a marked contrast to the previous investigations in the same field. It is furthermore interesting to note that whenever the cellulose-dextrose relationship has been brought into question, the question has not been raised as the result of some investigators' lack of critique, but because of certain reactions (like the bromomethyl furfural reaction of Fenton and Gostling) which were themselves far from quantitative, and the mechanism of which was not fully understood.

During the course of the myriad cellulose investigations that have crowded our literature, a number of so-called "compounds" of cellulose have been isolated and characterized. Let us examine briefly the case of the "oxycelluloses," compounds obtained by the oxidation of cellulose. There is no necessity of reviewing the methods of formation, or the properties of these substances. If we accept Hibbert's view of the constitution of cellulose, the oxidation of cellu-

[2] *J. Chem. Soc., 5,* 17 (1853).
[3] *Ber., 40,* 3876 (1907).
[4] *Chemiker-Ztg., 25,* 610 (1901).
[5] "Cellulose," p. 23.
[6] *J. Soc. Chem. Ind.,* 28, 641 (1909).
[7] *J. Physical Chem., 20,* 32 (1916).
[8] *J. Chem. Soc.,* 117, 1490 (1920).
[9] *Z. physiolog. Chem.,* 7, 523 (1883).
[10] *Ber.,* 43, 913 (1910).
[11] *Ber.,* 46, 2401 (1913).
[12] *Chem. Ztg.,* 34, 461 (1910).

lose might run the entire gamut of hydroxyaldehydes, hydroxyketones, hydroxyacids, ketoacids, etc., that could result from a product having two secondary and one primary alcohol groups for each six carbon atoms. Since the oxidation reaction is not infrequently accompanied by hydrolysis, the possible number of products is accordingly increased. We have here a limitless field for speculation, and can think of an indefinite number of oxycelluloses, depending upon the type of oxidizing agent, the conditions of oxidation, on the amount of oxidation product adsorbed on the residual cellulose, and possibly on other factors as well. It is quite evident that we can hardly hope for a homogeneous substance, and it is obvious that oxycellulose is a very vague and illusive term. It has no particular chemical significance and yet it persists in our present-day text-books on cellulose. The term "hydrocellulose" and "cellulose hydrates" enjoy a similar distinction. The former has been shown to be a mixture of hydrolytic degradation products of cellulose and cellulose itself. Whereas the latter (in many cases at least) appears to be cellulose itself—changed physically it is true—but hardly meriting the term applied to it.

I might continue further and point out the incongruities in our literature on lignocellulose and the other so-called "compound celluloses," or the ever-shifting meaning of the term cellulose itself when applied to a substance other than the seed hairs of the cotton plant. Further reference is unnecessary however. It is quite clear that we have certain chemically meaningless but highly respected terms in our cellulose literature, that the results of numberless experiments remain uncorrelated with the properties of the typical cellulose and that our cellulose literature is becoming increasingly unwieldy. I hasten to add, however, that in certain quarters this lack of critique and cohesion is rapidly being remedied—and it is in these quarters that our monographers should seek their inspiration.

To my mind, the primary objects of any monograph on cellulose are: (1) to stimulate further research along scientifically profitable channels; (2) to present the literature in such a way that the reader may have a reliable means of knowing whether or not previous statements can be accepted without reservation; (3) to present the data with a view towards giving the reader a comprehensive survey of the cellulose field without losing him in a maze of detail; (4) to pave the way for a more satisfactory definition of the term cellulose.

To gain these objectives, the author should remain uninfluenced (whenever necessary) by the orthodox procedure of previous writers, and should approach his problem in an essentially modern spirit. He must effect a liaison between some of the hitherto isolated facts in cellulose chemistry. He should use the greatest critical ability at his command, and give weight to results of those investigators who have used proper critique in their own work. Furthermore, he should select his material in such a way that with slight revision and proper additions, the work would remain a standard book of reference for a number of years to come.

It is quite possible to cleverly compile into a scholarly treatise (or series of treatises) a mass of detailed information—but such a volume would hardly meet our requirements. We need a critical compilation—suggestively written—that will give due weight to important qualitative reactions of cellulose and to the results of quantitative studies as well. The danger of formulating hypotheses on the basis of purely qualitative reactions should be constantly kept in mind. Articles in which unwarranted conclusions have been drawn without sufficient data, or in which the critic of the investigator is questionable should be subordinated or entirely deleted. Many of the vague terms now in common usage in the cellulose literature should be redefined or excluded.

Technological aspects of cellulose chemistry deserve no place in such a monograph. Paradoxical as it may seem, such a volume should in the end prove more serviceable and suggestive to the cellulose industry than would one which is diluted with references to the technological processes. This is especially true since we are already in possession of some noteworthy monographs in which these

technological processes have been compiled with the greatest patience and industry.

At the outset it would be advisable to publish only one monograph dealing with cellulose chemistry. It would be unfortunate if the society published a series of separate monographs on such subjects as (let us say) cellulose hydrates or oxycellulose. If one monograph cannot be made the joint work of two authors (an organic and a physical chemist), it might be well to have two monographs, one on the "chemistry of cellulose," and one on "cellulose as a colloid." Needless to say these books should supplement each other. I can not help feeling that an extended series must lead us into the same difficulties that we have encountered in the past, and I do not think that such a series would prove a good investment. Certainly the details in a number of volumes of an extended series would be obsolete in a comparatively short time. A carefully written volume of 300–400 pages with a properly classified bibliography should serve our purpose better than would an entire series.

I claim no originality for the ideas set forth nor are they Utopian. They form the basis of Heuser's recent "Lehrbuch der Cellulose Chemie." From the standpoint of the organic chemist, Heuser's Lehrbuch is the best monograph in its field. Unfortunately it was published several months too early to include the results of Hibbert's and Irvine's work on cellulose and Haworth's work on cellobiose, and it suffers accordingly. Heuser has written with a clear vision of the requirements of a modern monograph on cellulose. His writing is singularly free from circumlocution and from perplexing detail. He develops his subject matter clearly and logically. He has, however, omitted full reference to the modern work on the colloidal chemistry of cellulose, an oversight that should be corrected in any American monograph.

Summary.—(1) We require a monograph on the chemistry of cellulose that briefly and critically presents the most noteworthy results in the cellulose field. (2) The monograph must be more than a painstaking compilation. (3) It should carefully select the literature dealing with the most important reactions of cellulose as well as the results of the more recent researches on the physical properties of cellulose. (4) It should be written to stimulate fundamental research. (5) It should be free from inconsequential or meaningless terms and hypotheses.

Louis E. Wise

N. Y. State College of Forestry,
Syracuse, N. Y.

EUGENICS—THE AMERICAN AND NORWEGIAN PROGRAMS

Dr. Jon Alfred Mjøen, recognized by the Norwegian Government as the leader in eugenic and hygienic reform, issued from the Winderen Laboratorium, May, 1908, the following "Program for Race Hygiene":

Negative Race Hygiene. (*a*) *Segregation* (negative colonization system) for feeble minded, epileptics and similar physically and mentally crippled individuals, obligatory for drunkards, habitual criminals, professional beggars and all who refuse to work. (*b*) *Sterilization.* No compulsory sterilization in general. *Certain types* of criminals who wish to escape segregation should be given an opportunity to be sterilized.

Positive Race Hygiene. (*c*) *Biological Enlightenment.* Education of women in school and university should be changed from the present masculine system to one adapted to the female intellect and mind. Biology (renewal of the family), chemistry (nourishment of the family), and hygiene (protection of the family) should be chief subjects (obligatory), from the preliminary class in the boarding school to the university.—Race biology in school and university institute for genealogical research. State laboratory for race hygiene. (*d*) *Tax-, Wage-* and *Colonization*-system in favor of families, maternity insurance and other protective measures of prenatal kind. Positive colonization system. Regressive tax and progressive wage system for heads of families.

Prophylactic Race Hygiene. (*e*) *Combating racial poisons:* industrial poisons, especially lead and lead compounds; pathological poisons, especially syphilis; narcotic poisons, especially alcohol. (1) Prophylaxis of race illnesses and race anomalies as a state function. (2) Health declaration before marriage. (3) Class-system and progressive taxation for alcoholic liquors. (*f*) Crossings between

distant races should—until we have collected more knowledge—be avoided.

Doctor Mjøen has requested the writer to add his comments and to epitomize the situation in America. The writer has sent the following reply:

In general I approve of the Program for Race Hygiene issued from the Winderen Laboratorium in May, 1908, under Dr. Jon Alfred Mjøen, but I would like to add that there are special aspects of the problem as presented in America.

(*a*) *Education.*—The aspect of the race hygiene or eugenics movement which interests us most with respect to the United States of America is *popular education.* Legislation, both positive and negative, in this country will be of little avail unless supported by widespread popular knowledge and popular sentiment. When we witness the amazing progress that has been made in this country during the last twenty-five years regarding personal hygiene and especially the manner in which the discoveries of Pasteur, of Koch, of Lister, of Dakin, Carrel and others have become matters of common knowledge and practise among the people, we should not despair of creating similar widespread reform in family life through popular education. In fact an excellent beginning has been made in our schools and colleges towards both positive and negative race hygiene. Matters which were not considered proper even to mention twenty years ago are now simply and naturally spoken of as being of very great importance to the future of the race.

(*b*) *State Legislation.*—Many of the American state governments have become suddenly aroused to the fact that money which should be devoted to education, to public utilities, to sound and healthy amusement of our population, is diverted to the humanitarian care of members of society who are of no service to the state and who, unless cared for and segregated, are actually a menace to the state as well as a very serious economic loss.

(*c*) *Immigration.*—The American political principle that all men are created free and equal, while designed to indicate that all men should have equal rights before the law, has been interpreted to mean racial equality in intellectual, spiritual, moral, and physical endowment; investigations made during the World War struck a very hard blow to such American optimism. We discovered, for example, that our people, on the average, had lost two and a half inches in stature since the Civil War; that races like the English, the Irish, and the Scotch, coming from a similar geographic region, show marked inequality in intelligence. At the very bottom of the list stand certain races from central Europe which have been coming to America in enormous numbers. It is facts of this kind, brought by anthropologists to the attention of the American Congress, which have led to a very careful survey and restriction of immigration.

(*d*) *The Outlook.*—While we are aware that we are rapidly losing some of the best elements of our old American stock, which is being replaced in some regions by very inferior stock, we do not regard the outlook as discouraging, provided we act immediately, without prejudice, and openly, and make our strongest appeal to national sentiment. America has shown over and over again that she can make any sacrifice, and make it very quickly, if she is assured that the sacrifice is necessary for the preservation of her institutions on which the common safety and welfare depend. Consequently this is no time for discouragement, but the time for a very strong appeal to the patriotism of our people.

At a meeting of the members of the International Commission, namely, Leonard Darwin (President of the first Congress), Lucien March (representative of the French Government), Raymond Pearl (of Johns Hopkins University), Charles B. Davenport (of the Carnegie Institution of Washington, Cold Spring Harbor, New York), in consultation with ten leading representatives from other countries and from the United States, an *ad interim* committee was appointed to continue the work of the Congress until a permanent American committee could be selected by the main International Commission, which has its seat in London. In this connection the following letter was addressed by the writer to Professor Irving Fisher of Yale University:

October the eleventh,
Nineteen hundred twenty-one

You will recall that the Congress authorized the appointment of an *ad interim* committee to carry on the work in America prior to the appointment by the International Commission. I have consulted with Major Leonard Darwin and Dr. Jon Alfred Mjøen on this subject and they agree with me that the wisest choice we could make of a Chairman is Professor Irving Fisher of Yale University. The *ad interim* committee will then be composed as follows:

Irving Fisher, Chairman, of Yale University,
Charles B. Davenport, Vice-Chairman, of the Carnegie Institution of Washington, Cold Spring Harbor, N. Y.,
Harry Olson, Judge of the Municipal Courts of Chicago, Illinois,
Madison Grant, Chairman of the New York Zoological Society,
C. C. Little, Secretary, of New York, Secretary of the Second Eugenics Congress.

We shall thus have different sections of the country well represented; we shall profit by the legislative experience of Mr. Grant and Judge Olson and the expert scientific knowledge of Drs. Davenport and Little. As soon as the Eugenics Exhibit closes at the American Museum, the offices may be transferred to the American Eugenics Record Office at Cold Spring Harbor.

The present executive committee will disband as soon as the costs of the Congress are adjusted and the publication of the volume of papers and proceedings is arranged for.

I have appointed the following Committee on Publication of the *Proceedings* of the Second International Congress:

Charles B. Davenport, Chairman,
Clark Wissler, American Museum of Natural History,
H. H. Laughlin, American Eugenics Record Office, Cold Spring Harbor, N. Y.,
Henry Fairfield Osborn, *ex-officio*.

It is estimated that the publication will cost between $5,000 and $10,000, and I am writing to each of the great Foundations, namely, Carnegie, Rockefeller, and Commonwealth, asking for assistance, as the executive committee still has to raise a considerable sum to cover the expenses of the Congress.

According to the above terms it is proposed to actively disseminate the very valuable information contained in the seventy scientific papers and addresses presented to the congress by leading experts, also to provide for the continuation of the eugenics propaganda throughout the country. The writer retires from further active participation in this work in order to resume other duties. All inquiries should be addressed either to the Chairman, Vice-Chairman, or Secretary of the *ad interim* committee.

Henry Fairfield Osborn,
President, Second International Congress of Eugenics

New York,
October, 1921

SAMUEL STOCKTON VOORHEES

On the evening of September 23, at Portland, Maine, died Samuel Stockton Voorhees, Engineer Chemist of the Bureau of Standards, in the fifty-fifth year of his age. To a host of friends his passing brings personal sorrow because of loss of one endeared to them by his genial and manly qualities and deep regret that the chemical profession should be prematurely deprived of the services of a man so well informed and broadminded, whose conduct was always guided by high ideals.

Voorhees was born at Springfield, Ohio, January 15, 1867, his parents, of old American stock, being John Hunn and Elizabeth Aston (Warder) Voorhees. He studied at Lehigh University, in the class of 1888 without graduating and then took a special course in chemistry at Columbian (now George Washington) University, in Washington, D. C. He married in 1895 Laura Toucey Kase, of Danville, Pa., who with three daughters survive.

His first professional services were with the Cambria Iron Company, at Johnstown, Pa., and the Pennsylvania Railroad, at Altoona, Pa. In the employ of the latter he had the good fortune to be associated with the lamented Dr. Charles B. Dudley, a past president of the American Chemical Society, whom he always held in grateful remembrance. He there also formed lasting acquaintance with men who have risen to prominence in the railroad world. It was with two of them and other friends that he undertook the vacation trip to the north woods of Maine, where an illness from which he had long suffered developed to such an extent that he had to be removed under great difficulties to a hospital in Portland, where within a week he underwent two operations, from the second of which he was unable to rally.

Voorhees's railroad experience was continued during 1896 to 1899 with the Southern Railway Company at Washington, D. C., and Alexandria, Va., and from 1899 to 1901 with the New York Central and Hudson River Railroad, at Albany, N. Y.

The fifteen years of practical knowledge acquired in industrial fields fitted him admi-

rably for the government service into which he now entered and in which he remained during the rest of his life. From 1901 to 1908 he was engineer of tests in the office of the supervising architect of the Treasury Department and continued that work until 1910 after it was taken over by the Technologic Branch of the Geological Survey. In 1910 this service was transferred to the Bureau of Standards, where it has since remained.

Voorhees was at the time of his death a member of the American Chemical Society, the American Association for the Advancement of Science, the Washington Academy of Sciences, the Biological Society of Washington, the American Society for Testing Materials, and the International Association for Testing Materials. He was long a member also of the Society of Chemical Industry. In the American Society for Testing Materials he was most active, serving a term as vice-president and frequently on committees, participating in the preparation of many reports. It is upon these reports and the very many that he rendered in government service that Voorhees's professional reputation chiefly rests. His long and varied experience in the fields of railroad and structural supplies gave him a practical knowledge and a grasp of the applications of those materials such as few men possess.

Associated as I was with him for over eleven years at the Bureau of Standards, where he was in charge of a section of the chemistry division, I bear glad testimony to his intense loyalty to our government and to his unflagging zeal and industry on its behalf. To aid the government, the public and the industries was his constant aim. I also wish to acknowledge my own indebtedness for the strong support and wise counsel that were ever at my service. His loss left a void in the Bureau of Standards that will be hard to fill.

The social side of Voorhees was strongly developed. He was an active member of the Cosmos Club of Washington, enjoyed the company of others and contributed to their enjoyment, whether as genial entertainer or attentive listener, always the courtly gentleman. His disposition was most kindly, and any friend or neighbor in trouble or sickness was sure of his solicitous attention. Voorhees was an ardent fisherman, and it was with evident anticipations of a good time with the finny tribe that he set out on his trip to the Maine woods. His last note to me from camp, however, raised forebodings as he told of his inability to join in the sport he so enjoyed. Peace to the spirit of a fine man and a faithful friend.

W. F. HILLEBRAND

SCIENTIFIC EVENTS

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS' ASSOCIATION OF THE UNITED STATES

REPRESENTATIVE manufacturers of synthetic organic chemicals met at Washington on October 28 and 29 to effect a comprehensive national organization of the several closely related lines of manufacture included in this branch of chemical industry.

The name of the new organization is Synthetic Organic Chemical Manufacturers' Association of the United States. Its purposes, as set forth in the Constitution adopted, are

> To advance the science of organic chemistry by encouraging the manufacture in the United States of all kinds of organic chemicals; to cooperate with the various agencies of the Government of the United States in its efforts to develop, improve and render serviceable a complete organic chemical industry; to promote cordial relations between American concerns and individuals engaged in the production and use of organic chemicals; to afford means for the dissemination of scientific knowledge; to promote the highest scientific and business standards in relation to the industry; and generally to take such collective action as may be proper for the establishment and perpetuation of the organic chemical independence of the United States of America.

The association is subdivided into four sections—Dyestuffs, Pharmaceuticals, Intermediates and Fine Organic Chemicals—each section having a vice-president, a secretary and an executive committee. The administration of the association is in the hands of a board of governors, consisting of the president, the four vice-presidents, and ten members nominated by the sections.

The following officers were elected:

President: Chas. H. Herty, formerly editor of the *Journal of Industrial and Engineering Chemistry.*

Vice-Presidents: C. N. Turner of the Dyestuff Section; Herman Seydell of the Pharmaceutical Section; S. W. Wilder of the Intermediate Section; B. T. Bush of the Fine Organic Chemical Section.

Members of the Board of Governors: R. S. Burdick; R. C. Jeffcott; August Merz; M. R. Poucher; P. Schleussner and F. P. Summers.

The remaining four members of the Board of Governors, one from each section, will be elected later. The president and the four vice-presidents are ex-officio members of the board of governors.

THE EDITORSHIP OF THE "JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY"

Mr. Harrison E. Howe has been elected to succeed Dr. Charles H. Herty as editor of the *Journal of Industrial and Engineering Chemistry* and director of the A. C. S. News Service, which are conducted by the American Chemical Society. Dr. Charles L. Parsons, of Washington, secretary of the society, states that Mr. Howe has accepted the positions.

Mr. Howe was graduated from Earlham College and the University of Rochester. As chief chemist of the Sanilac Sugar Refining Company, in like capacity with the Bausch and Lomb Optical Company of Rochester, New York, and as manager of the commercial department of A. D. Little, Incorporated, of Boston, and manager of the Montreal offices of that organization, he became familiar with the broadest phases of industrial chemistry. In the war he was consulting chemist of the nitrate division of the Ordnance Bureau of the United States Army. Until his election to his present position Mr. Howe was at the head of the division of research extension of the National Research Council. He writes extensively for magazines on applied chemistry and is the author of a recently published popular work, "The New Stone Age."

Dr. Herty resigned the editorship to which Mr. Howe succeeds to accept the presidency of the newly formed Synthetic Organic Chemical Manufacturers' Association of the United States, which has opened offices on the 34th floor of the Metropolitan Tower at No. 1 Madison Avenue. Dr. Herty's career in chemical journalism has been varied by many public activities. By special appointment of President Wilson he went to Paris in 1919 as the representative of the United States in the matter of the distribution of German dyestuffs under the economic clauses of the Peace Treaty. Dr. Herty was also chairman of the committee of the American Chemical Society advisory to the Chemical Warfare Service, member of the dye advisory committee of the Department of State, and chairman of the advisory committee of the National Exposition of Chemical Industries. Before beginning this work, Dr. Herty had been a professor in chemistry at the University of Georgia and at the University of North Carolina. In his new position he will devote himself to the development of American synthetic organic chemical industry.

DIRECTOR OF THE HARVARD COLLEGE OBSERVATORY

As was noted last week in Science, Dr. Harlow Shapley, formerly of the Mt. Wilson Solar Observatory at Pasadena, Cal., and for the past eight months observer at the Harvard College Observatory, has been appointed director of the Harvard Observatory. That post has been vacant since the death of Professor Edward C. Pickering in 1919.

An article in the *Harvard Alumni Bulletin* states that Dr. Shapley was born thirty-five years ago at Nashville, Miss. He studied at the University of Missouri, and received the degree of Ph.D. at Princeton. From 1914 until last spring, when he came to Harvard, he was attached to the Mt. Wilson Observatory.

At Mt. Wilson he perfected methods of measuring star distances photometrically, and applied these methods to the problem of the distances and structures of the great star-clusters. His work has given a new perception of the size of the stellar universe, and

shown that it is at least a thousand times larger than it was thought to be before the distances to the clusters were measured. Dr. Shapley has discovered, furthermore, that the sun is not at the center of the sidereal universe, as was formerly supposed, but several hundred quadrillion miles away from it.

Dr. Shapley's studies of the famous star-cluster in Hercules known as "Messier 13" have proved that this cluster has a diameter of more than two and a half quadrillion miles, and contains probably more than 50,000 stars, each of them intrinsically brighter than the sun. His researches have also played a large part in establishing the fact that the great star-clusters are found only at immense distances from the plane of the galaxy, or Milky Way, but appear to be falling into it. Dr. Shapley's hypothesis is that the Milky Way itself may be composed of former star-clusters which have dissolved.

Dr. Shapley is also known as an entomologist, and has done interesting work in investigating the ants of the California mountains. He discovered that the speed at which these creatures move depends on the temperature, and that for some species the time of running through a "speed-trap," as shown by the stop-watch, gives the temperature of the surrounding air within one degree. He found that the ants went twelve times as fast at 100 degrees as at 50 degrees.

Professor Solon I. Bailey, who has been associated with the Harvard Observatory for more than thirty years and has been Acting Director since the death of Professor Pickering, expects to leave Cambridge within a few months for Arequipa, Peru, to take charge of Harvard's South American astronomical station there and place it again on a productive basis after a period of dormancy due to war conditions. He will resume his observations on the variable stars in southern clusters.

A SOUTHERN FOREST EXPERIMENT STATION

DURING July a new forest experiment station was established by the Forest Service of the U. S. Department of Agriculture, with headquarters, for the present, at New Orleans, La. Experiments will be conducted in the large and important timber region extending from eastern Texas, through Louisiana, Arkansas, Mississippi, Alabama, Georgia, Florida, to the Carolinas. Mr. R. D. Forbes, until recently superintendent of forestry for the Conservation Commission of Louisiana, has accepted the directorship of the station. Mr. Lenthall Wyman, formerly a member of the Forest Service in Arizona and Montana, and more recently in the State Forester's office in Texas, will be one member of the staff. Mr. W. R. B. Hine, a recent graduate of the Cornell School of Forestry, is the second member. One vacancy in the technical staff remains to be filled.

The importance of this region, in which large areas of land are suitable only for growing timber, makes the establishment of this station, to work out the best methods of producing, growing, and protecting the forests, particularly opportune. Such important and valuable species as longleaf, shortleaf and loblolly pines, and cypress amply justify a considerable outlay to insure their perpetuation and increase their production.

The establishment of the Southern Forest Experiment Station was made possible by a small increase in the appropriation for the investigative work of the Forest Service for the present year. It is not sufficient to permit the construction of buildings and laboratory facilities, and it is planned for the first year to concentrate on field work in the most urgent problems.

ORGANIZATION FOR RESEARCH AT THE PENNSYLVANIA STATE COLLEGE

THE members of the American Association for the Advancement of Science at the Pennsylvania State College, State College, Pa., held a meeting on November 2. Dinner was served at the University Club to about thirty members. The speaker was Dr. L. R. Jones, professor of plant pathology of the University of Wisconsin and chairman of the Division of Biology and Agriculture of the National Research Council. His theme at this

meeting was "Organization for Research," in which he developed the idea of scientific research as a public service, not only in time of war but in time of peace as well, using the University of Wisconsin as an example of a state university functioning as a great public service institution through research work for the public good. He further showed how the modern state university is distinguished from the academy, the earlier type of educational institution, from the college, the modern institution which has replaced the academy in the matter of instruction, and from the modern endowed university, by the enlarged program of research for the public good which distinguishes the state university. Dr. Jones suggested as a means of fulfilling this public trust at state institutions the organization of "research committees" and "faculty subject groups" which are formed without regard to collegiate divisions. These are definite means of promulgating throughout the institution the relative importance of research as compared with other lines of activity and of emphasizing research as a much needed form of public service.

At the meeting it was voted by the members to petition the national council for a charter to form a local branch to be known as the Pennsylvania State College Branch of the American Association for the Advancement of Science. The purpose of the organization is to promote and stimulate research in the institution.

SIGMA XI LECTURES AT YALE UNIVERSITY

At a meeting on November 8 of the Yale Chapter of the Society of Sigma Xi, which was addressed by President James R. Angell of the University, announcement was made of a series of lectures to be given under the auspices of the Yale Chapter on the general topic of "The evolution of man." The lecturers and their subjects are considered of such general interest that it has been decided to hold the series this year in Lampson Lyceum, and to invite the public to attend the lectures without charge.

The first lecture of the series will be given on the evening of December 2, on "The antiquity of man," by Professor Richard S. Lull of the university faculty. The following are the subjects of the succeeding four lectures, which will continue through the month of March:

The natural history of man—Professor H. B. Ferris.

The evolution of the nervous system of man—Professor G. H. Parker.

Societal evolution—Professor A. G. Keller.

The direction of evolution—Professor Edwin G. Conklin.

It is expected that the 1921–22 lectures under the auspices of the Society of Sigma Xi will, as in the past, be published by the Yale University Press.

SCIENTIFIC NOTES AND NEWS

As a memorial to the late Edward C. Pickering, for forty-two years director of the Harvard College Observatory, it is proposed to erect near Cambridge an astronomical observatory, whose work will be largely concerned with the study of variable stars.

Dr. Harvey Cushing, of Harvard University and the Peter Bent Brigham Hospital, was elected president of the American College of Surgeons at its recent meeting in Philadelphia.

The Franklin Institute of Pennsylvania has awarded its Howard N. Potts gold medal to Dr. E. V. McCollum, professor of chemical hygiene in the School of Hygiene and Public Health of the Johns Hopkins University. The medal is awarded "for distinguished work in science or the mechanic arts," and was presented by the institute in recognition of a lecture on "Nutrition and physical efficiency," delivered before its members in 1920.

Sir J. J. Thomson succeeds Sir Richard Glazebrook as president of the Institute of Physics, London.

The Royal Society of Edinburgh has elected as president Professor F. O. Bower. The vice-presidents are Sir G. A. Berry, Professor W. Peddie, Sir J. A. Ewing, Professor J. W.

Gregory, Major-General W. B. Bannerman and Dr. W. A. Tait.

WE learn from *Nature* that Professor Léon Fredericq is to be presented with a medallion in recognition of his distinguished services as professor of physiology for fifty years in the University of Liège. The presentation will take place this month, when his son will take the chair which Professor Léon Fredericq has held so long.

THE quinquennial prize for the best work in medical sciences, offered by the Brussels Academy of Medicine, has been awarded to Dr. A. Brachet, professor of anatomy and embryology of the University of Brussels, for his contributions to topographical anatomy.

THE Italian Society of Internal Medicine at its eighteenth congress in Naples on October 26, celebrated the ninetieth year of Professor Cardarelli, and the fortieth year of Professor Maragliano's work as teacher. These physicians are the directors of *La Riforma Medica,* one of the chief medical journals published in Italy.

PROFESSOR P. GUTHNICK has been appointed director of the Babelsberg Observatory in succession to the late Herman Struve.

ERNEST P. BICKNELL, who has been representing the Red Cross abroad, has been appointed American National Red Cross Commissioner for Europe.

DR. H. C. DICKINSON, chief of the automotive investigations division of the Bureau of Standards, has been granted a leave of absence to become director of research for the Society of Automotive Engineers. He will continue to assist in the work of the bureau in a consulting capacity.

SECRETARY OF LABOR DAVIS has appointed a special committee to consider the welfare of immigrants coming through the principal ports of entry of the United States. The members are: Fred C. Croxton, chairman of the Ohio Council of Social Agencies; Miss Julia Lathrop, former head of the U. S. Children's Bureau; Miss Lola D. Lasker, of New York.

DR. WILFRED H. OSGOOD has been appointed curator of the department of zoology in the Field Museum of Natural History.

A GEOLOGICAL party of four, consisting of Professors R. A. Daly and Charles Palache of Harvard University, Professor G. A. F. Molengraaf of the University of Delft, Holland, and Dr. F. E. Wright of the Geophysical Laboratory, Carnegie Institution of Washington, will spend the coming winter in southern Africa. in a geologic and petrologic study of the Bushfeld igneous complex in Transvaal.

THE council of the California Academy of Sciences announces the appointment of Dr. Barton Warren Evermann as director of the new Steinhart Aquarium. The duties of this position will be in addition to those of director of the Museum of the California Academy of Sciences, which Dr. Evermann has held for many years. It was through Dr. Evermann's interest in fishes and aquariums that the late Mr. Ignatz Steinhart was induced to give to the California Academy of Sciences $250,000 for the construction and equipment of a public aquarium building in San Francisco. The council has selected Mr. Alvin Seale to be superintendent of the aquarium. For several years Mr. Seale was director of fisheries of the Philippine Islands. He also planned the Manila Aquarium, of which he was director during his several years' residence in the Philippines. He will be on duty throughout the period of construction and thereafter. The aquarium will be situated in Golden Gate Park, San Francisco, immediately adjoining the present museum of the academy.

THE new hospital of the Manchester and District Radium Institute was opened on October 7, by Lord Derby. It is the first hospital in England to be used exclusively for radium treatment.

BERT HOLMES HITE, chief chemist of the Virginia Experiment Station since 1895, professor of agricultural chemistry in the University of West Virginia since 1898, has died at the age of fifty-five years.

Miss Eunice Rockwood Oberly, librarian of the Bureau of Plant Industry of the Department of Agriculture since 1908, whose knowledge of the organization and relations of phytopathological literature was probably unique, died suddenly at her home in Washington on the morning of November 5.

John Augustine Zahm died in Munich, Bavaria, of pneumonia, on November 11. Dr. Zahm was born in Ohio and graduated in 1871 from Notre Dame, with which university he was connected for many years as head of its scientific department, as curator of its museum, and then as president of the board of trustees. He was the author of numerous books concerned largely with the relations of science to religion.

Dr. Emil A. Budde, the German electrical engineer, died recently at the age of eighty. He was president of the International Electrochemical Commission, succeeding Dr. Elihu Thomson.

The president and council of the Royal Society, London, announce that, in view of the economic condition of the country, the anniversary dinner of the society will not be held this year.

UNIVERSITY AND EDUCATIONAL NEWS

Sir Edward Allen Brotherton, Bt., M.P., has given £20,000 to the University of Leeds for the development of bacterial study and research, more particularly in the interests of public health.

A verdict of $25,000 damages has been rendered against Cornell University in the action brought by Louise Hamburger '20. In making his charge to the jury, Justice Kellogg said that the verdict to be given rested upon one point only, as to whether the university was negligent in employing a small boy in the chemistry stock-room. A motion for retrial has been made.

R. S. Lowe, of the Nitrate Division of the Ordnance Department of the Army, has been appointed dean of the department of chemical engineering of the University of Cincinnati.

C. R. Alden, formerly dean of the school of engineering, Institute of Technology, Detroit, has accepted an appointment as dean of the college of engineering, Ohio Northern University, Ada, Ohio.

Among changes in the medical faculty at Yale are: Dr. Francis G. Blake appointed John Slate Ely professor of medicine; Dr. Edwards Albert Park, professor of pediatrics; Dr. Arthur M. Morse, professor and head of the department of obstetrics and gynecology; Dr. John T. Peters, Jr., associate professor of medicine and Dr. Albert T. Shoal, associate professor of pediatrics. Dr. Samuel C. Hardey, associate professor of surgery, has been placed in charge of the surgical department of the school.

Dr. Lansing S. Wells, until recently a research chemist with the Barrett Company, Frankford, Philadelphia, Pa., has accepted an appointment as assistant professor of organic and physical chemistry, Montana State College, Bozeman.

Professor H. C. Plummer, F.R.S., has been appointed professor of mathematics of the Ordnance College, Woolwich, England.

At the opening of the winter session of St. Andrews University, Scotland, the newly appointed professor of chemistry, Dr. Robert Robinson, F.R.S., and the newly appointed professor of bacteriology, Dr. William J. Tullock, were inducted into their respective offices.

DISCUSSION AND CORRESPONDENCE

LATITUDE AND VERTEBRÆ

To the Editor of Science: In Science for December 26, 1919, is a suggestive note by Mr. A. G. Huntsman on the problem of "Latitude and Vertebræ" among fishes, a problem of reality and importance which I have thus had mostly to myself, and to which I have failed to find a solution. As Mr. Huntsman observes, not only have the northern species a progressively increased number of vertebræ, but a similar variation may occur within the limits of the species itself. In the flounder, *Hippoglossoides platessoides*, the northern examples have most vertebræ, while in the herring—*Clupea harengus*, the numbers of vertebræ decrease in passing from the

open sea, dense, saline and cold, to the Baltic. For this reason Mr. Huntsman suggests that the density of the surface water in which the eggs develop may be a decisive element.

In this connection, I may add a few additional data. In the group of Rock Cod or Rose-fish (*Sebastinæ*), the northern genera (*Sebastes, Sebastolobus*) have twenty-nine to thirty-one vertebræ, the tropical forms nearest related twenty-four, and the intermediate group of many species on both sides of the Pacific (*Sebastodes* and its allies) were supposed to have twenty-seven.

In verifying this statement I find that four of the more primitive of these forms (*Sebastodes paucispinis, S. goodei, Rosicola pinniger* and *R. miniatus*, have but twenty-five vertebræ, while all the others examined have twenty-seven as supposed, and the metameres in the very young are also twenty-seven.

Hitherto the extinct species of this tribe have remained unknown. I have, however, lately discovered three Miocene species, which ought to throw light on the problem. At any rate they show that the variation is of long standing.

Two fossil species with thirteen dorsal species, *Rixator porteousi* and *R. ineziæ*, related to *Sebastodes goodei*, have, like the latter species, twenty-four vertebræ, besides the last one which supports the hypural. This is evidence so far as it goes that the smaller number (with greater individual development of the bones) is very ancient. Nearly all the spiny-rayed shore fishes of the present day have twenty-five.

But another fish of this type—also Miocene (*Sebastavus vertebralis*), has thirty-two vertebræ. The relation of this species to existing forms is not close, nor is it well made out. All three of these Miocene species are found in deposits made in shallow, sheltered bays, in a temperate climate. As Mr. Huntsman observes, "A fruitful field for investigation is open in this direction." It should apparently involve both embryology and paleontology, as well as the study of adult fishes and their distribution.

DAVID STARR JORDAN

ABSTRACTS AND TITLES OF SCIENTIFIC ARTICLES FROM THE LIBRARIAN'S STANDPOINT

TO THE EDITOR OF SCIENCE: In his article on "Scientific Abstracting" in SCIENCE for ...ber 30, Mr. Fulcher emphasizes the point that the time of research men should be conserved for their actual research by facilitating for them in every way the securing of the scientific information already published. No one would dispute this statement, and its truth is becoming increasingly striking as the mass of literature yearly accumulates, but it is suggested that from his list of the agencies contributing to this end as a part of what he calls "our scientific information service" Mr. Fulcher has omitted a very necessary and important agency, namely, the scientific library. A library of a scientific institution has no other purpose than to collect and make available the literature on the subjects of interest to that institution, and anything which facilitates this work is ultimately of benefit to the investigators. There is no one to whom abstracts such as those pled for by Mr. Fulcher would be of greater help than to the scientific librarian or bibliographer. As he points out, it is impossible to rely on titles alone to show the variety of information contained in an article, so that it is necessary for a librarian compiling a subject catalogue to glance through each article so that he may be sure it is entered under all the subjects of which it treats. Abstracts in the form described, with the italicized paragraph headings and subtitles would suggest at a glance possible subject headings, and in the case of articles in highly specialized subjects would frequently suggest headings which, without the abstract, only the specialist would recognize as being desirable.

Speaking of this, the present writer has thought for a long time that it would be well for persons interested in increased economy and efficiency in the recording of scientific data to give the form of titles for periodical articles careful consideration. No title can, of course, describe all the contents of an article, but many could easily be more de-

scriptive than they are and contain information essential to a cataloguer or investigator, frequently obviating the necessity of an examination of the article itself to discover what it is really about. Take, for instance, titles like the following: "A spot disease of cauliflower," "Known species of smut on a new host," "A dangerous potato disease." Each of these titles shows in a general way what the article in question is about, but no one of them gives information essential for assigning subject headings, yet in each case this might have been done, still keeping the title concise and short. The title "A spot disease of cauliflower" omits the very important information that this is a new disease assigned to a new bacterial pathogene which is described in the paper, while "A spot disease of cauliflower caused by *Bacterium maculicolum* n. sp." gives the essential information and is not objectionably long. The title "Known species of smut on a new host" might much better be written "*Cintractia leucoderma* on a new host, *Cyperus gatesii*," and "A dangerous potato disease"—"A dangerous potato disease due to *Rhizoctonia violacea*" or "A dangerous *Rhizoctonia* disease of potatoes."

It may be difficult to assign satisfactory titles for articles on abstract subjects whose terminology is not definitely fixed, but in cases such as those mentioned above it is a simple matter to compose a clear and definite title giving the specific facts dealt with in the paper. The more definite titles would save time in the library not only in cataloging and bibliographical work, but would frequently prevent the necessity of the library's procuring a journal for an investigator on the chance that an article contained therein, whose title may have been seen in a catalog or list, may be on a subject in which he is interested. A clear and definite title shows at a glance whether the article should be read by an investigator working on a certain subject, while an ambiguous or indefinite title puts him under the necessity of looking up many articles only to find that they are not on his subject.

It would seem, therefore, well worth while for the National Research Council, or whatever agency is formulating the directions and rules for the preparation of analytic abstracts, to include with these directions for the preparation of titles for scientific articles. There are many points in addition to those which have been mentioned here, which should be considered, such as, for instance, the relation of the title of a preliminary abstract to the title of the complete paper appearing later, giving the same article in different journals different titles, the publishing of different articles on the same subject with identical titles, or, the continuation of an article with a title different from that of the first installment.

Eunice R. Oberly
Library, Bureau of Plant Industry,
U. S. Department of Agriculture

Longitudinal Electromagnetic Forces

To the Editor of Science: Last spring the writer sent a note to one of our well-known and carefully edited scientific journals for its correspondence column, announcing briefly that there are a number of good reasons for concluding that the old belief (expressed by Maxwell) that electromagnetic forces can act only perpendicularly to a conductor and never in the direction of its axis, seems to be wrong, and if so, it should be corrected.

The "advisers" of the editor on subjects pertaining to physics, recommended that the note "ought not to be published" as it was "so subversive of long-established principles." Five weeks later, the editor returned the note unpublished.

Physicists who have a more progressive spirit and may, therefore, be interested in such "heresies," and who are not hide-bound by beliefs whose chief qualification is the age of those beliefs, will find this subject more fully discussed by the writer in an article in the *Journal of the Franklin Institute* for November. This is also a carefully edited scientific journal, and one of its "advisers" on physical subjects (one of our leading physicists) recommended that "it is well worth publishing."

Thirteen years ago, the writer described an experiment in which the result was the direct opposite to that called for by reading on it one of the most prominent of the laws stated by Maxwell. The proposed paper describing it was rejected by one of our leading societies on the ground that if true (which was very easily demonstrated) it was such a serious matter to refute one of Maxwell's laws that it ought to be kept a secret! It is needless to say that the writer published it; broad-minded electro-physicists have accepted this correction of that law.

Let us hope that our younger physicists will be more progressive and will develop the true scientific spirit of desiring to be corrected when it can be shown that what they teach their students is wrong.

CARL HERING

PHILADELPHIA,
November 1, 1921

THE SCIENTIFIC BUREAUS OF THE GOVERNMENT

TO THE EDITOR OF SCIENCE: Since my return to Washington from my summer's field work my attention has been called several times to circulars which have been sent broadcast throughout the country by Mr. Arthur MacDonald, The Congressional, Washington, D.C., recommending the reorganization of all of the government scientific bureaus under the direction of the Smithsonian Institution. While the institution appreciates the confidence in it implied by his suggestion, I desire to point out that his scheme is entirely impracticable and was not suggested or authorized by the Smithsonian Institution, with which Mr. MacDonald is not connected in any way.

I shall be glad if you will have the goodness to publish the above in SCIENCE, in order that your readers may understand thoroughly that the institution is in no way responsible for this propaganda.

CHARLES D. WALCOTT,
Secretary

THE SMITHSONIAN INSTITUTION,
November 5, 1921

QUOTATIONS

MEETING OF THE AMERICAN ASSOCIATION IN CANADA

THE American Association for the Advancement of Science is to hold its annual meeting in Toronto this winter. The rules of the association, recently revised, give the term "American" a Continental instead of a national connotation, so that the visit to Canada will be regarded as a normal rather than as an extra-territorial event. There is thus a departure from the constitutional precedent of the British Association and of its French and German parallels. These bodies are national, although they welcome foreign guests, and have occasionally paid visits to foreign countries. Were the matter political, difficult questions might arise with regard to the proposed visit of the British Association to Toronto in 1924. The former visits of the British Association to Montreal and Toronto, and later to South Africa and Australia, were regarded as not different in kind from visits to Edinburgh or to Bournemouth. The formation since then of a South African Association for the Advancement of Science would certainly not place any obstacle in the way of another British visit to the Cape. The inclusion of Canada in the American sphere similarly should not affect the prospects of future visits of the British Association. It is all to the good that science should prefer geographical to political frontiers. We confess to a feeling of envy, however, when we read of the concessions made by American railways to science. The utmost efforts failed to extract from the British railways such reductions in fare to members of the British Association going to Edinburgh as they readily concede to pleasure parties and week-end excursions. The railroads of America are acting differently. Reduced rates for visitors to the Toronto meeting have been granted by all the railways of Canada and by those covering practically all the New England and Atlantic Coast States down to Virginia, and by those serving Ohio, Indiana, Michigan, and Illinois. Other concessions are expected, and so far as the railway journey

is concerned, scientific men throughout the vast continent will be given every inducement to attend the Toronto meeting.—*The London Times.*

SCIENTIFIC BOOKS

Text-Book of Geology. By Amadeus W. Grabau. Two volumes. Part 1, General Geology, 864 pages, 734 text figures; Part 2, Historical Geology, 976 pages, 1980 text figures. D. C. Heath & Co.

A text-book in science may be written, like other books, for name and fame; or to set forth new truth; or for desired remuneration (which may be in inverse ratio to value); or simply because the author can not help it. This latest ambitious addition to geologic literature is another expression of the mental activity and scientific industry of the author, as it is his third important and voluminous work within a few years. In 1909–1910 he published, in conjunction with H. W. Shimer, two handsome volumes on "North American Index Fossils," covering only the invertebrates, with 1762 pages and profusely illustrated. In 1913 he produced another original work, "Principles of Stratigraphy," with 1185 pages. This latest, if less original, work is even more voluminous.

Facing the writer are several shelves filled with the antiques of English and American geologic literature, text-books and treatises dating back to the early part of the last century. The striking comparison between the old and new invites a brief homily on the development of American geology, as illustrated by the text-books.

These oldest books are amusing and pitiful in their diminutive size, narrow scope, queer ideas, and their occasional illustrations of exceeding crudity. If Science admitted pictorial illustrations a comparison of the old cuts with modern engravings of the same subjects would show the progress of graphic art. The older books antedate photography, which has been the greatest aid in study of nature.

Many of the old books have a theologic flavor, and some close with a pious exhortation. Beginning with Leibnitz (1646–1716) the writers sought to harmonize the facts of the new science with ancient Hebrew philosophy, and in particular tried to prove that Moses really meant "day" when he wrote it (in English). While there are yet people who give to old Hebrew literature more credence than to modern science, the time has gone by when American authors of scientific works have to defer to superstition.

Geology as a recognized branch of study in the schools is less than a century old. As a systemized branch of science and a part of general culture of the educated man geology began with Charles Lyell. His masterly writings (1830–1857) proved the continuity of geologic processes and set the standard for geologic literature. Previous to about 1840 American students relied chiefly on English works, or on American reprints. As late as 1837 Edward Hitchcock republished De la Beche's "Researches in Theoretic Geology," a small octavo of 342 pages and with no illustrations.

The oldest American text-book in this file is a little duodecimo of 122 pages, with 17 pages of index and errata, by W. W. Mather, entitled "Elements of Geology for the use of Schools," date 1833. This has a very few small diagrammatic illustrations. The writer's copy has pasted in the front cover a printed commendation by B. Silliman, of date June 18, 1834.

Two other old books are "Outlines of Geology," 1837, 384 pages, by J. L. Comstock; "Elements of Geology," by Charles A. Lee, 1839, 375 pages.

The second period of American geologic literature (1841–1860) began with Edward Hitchcock's "Elementary Geology," 1841. For two decades this was the American authority, and by 1860 it had run to the 30th edition, with 424 pages. The publication of a number of volumes by other authors suggests the stimulus to scientific study. Three of these had the favorite title "Elements of Geology"; by Samuel St John, 1851 (334 pp.); Justin R. Loomis, 1852 (198 pp.); Ayonzo Gray and C. B. Adams, 1853 (354

pp.). "A familiar Compend of Geology" of 150 pages by A. M. Hillside is dated 1859.

The contents of these old books usually justify the modesty of their titles.

The third period of text-book evolution (1860–1904) began with Ebenezer Emmons's "Manual of Geology," 1860. This had only 297 pages, but included many illustrations. Indeed, this was the first book to make very large use of illustrations.

But in a few years Emmons's excellent work and the other books were displaced by the masterly "Manual of Geology" by James D. Dana. This was true to its title, for that time. The first edition, 1862, had 798 pages and 984 illustrations. The fourth edition, in 1895, had 1087 pages and 1575 illustrations. All the geologists of the period including the older geologists now living were "brought up" on Dana's Manual. To meet the demand for a small text Dana published in 1863 his "Text-Book," which was revised in 1897 by W. N. Rice.

The most popular work during this period for class-room use and as a treatise for general reading was Joseph LeConte's "Elements of Geology," first published in 1878. In LeConte's picturesque style, with profuse new illustrations, and emphasizing mountain structure and other features of the western part of the continent, it held the field for three decades, with several revisions; and it is yet in demand, although badly out of date on many topics. LeConte's "Compend," with 399 pages, appeared in 1884.

During the later years of this period several smaller texts appeared; by N. S. Shaler, "First Book in Geology," 1884 (255 pp.); Angelo Heilprin, "The Earth and Its Story," 1896 (267 pp.); R. S. Tarr, "Elementary Geology," 1897 (499 pp.); W. B. Scott, "An Introduction to Geology," 1897 (573 pp.). Some popular works or treatises were: Louis Agassiz, "Geological Sketches," 1866; Alexander Winchell, "Sketches of Creation," 1870; "Sparks from a Geologist's Hammer," 1870; "World Life, or Comparative Geology," 1883; T. Sterry Hunt, "Chemical and Geological Essays," 1875; J. W. Dawson, "The Story of the Earth and Man," 1873; N. S. Shaler, "Aspects of the Earth," 1889.

The year 1888 marks an epoch in American geology, in the organization of the Geological Society of America, and the beginning of a periodical devoted entirely to geology. The *American Geologist* was founded and conducted by N. H. Winchell and existed to 1905, making 36 volumes. The *Journal of Geology*, published by the University of Chicago, began its excellent work in 1893.

The next commanding work, in succession to Hitchcock, Dana and LeConte, was the three volumes of T. C. Chamberlin and R. D. Salisbury, in 1904–1906, aggregating 2,000 pages. This may be regarded as introducing the fourth and present period of American geologic literature.

Other excellent text-books of later years are the following, omitting titles; J. C. Branner, (a syllabus) 1902; W. H. Norton, 1905; Eliot Blackwelder and H. H. Barrows, 1911; Chamberlin and Salisbury (single volume), 1914; L. V. Pirsson and Charles Schuchert, 1915 (1051 pp., 522 figures); W. J. Miller, 1916 (covering only historical geology); H. F. Cleland, 1916.

The above relates only to general geology, but the volume of earth-science literature has been increased by superior text-books in economic or industrial geology, and in physiography. The great mass of publication by the national and state surveys does not belong in this review.

Recurring now to the work in hand; it is in many respects an excellent presentation of geology to date. The writer has good literary style, direct and lucid. Most topics are well handled and many are treated with fullness and in a masterly way. This is especially true of sedimentation problems, of paleozoic stratigraphy, and of the historical part in general.

The illustrations are profuse and usually pertinent. The portraits of eminent geologists of former times will give the student a more lively human element. The paleogeographic maps, in Part II., are drawn in clear outline, and interesting comparison will be

made with the maps by Schuchert, and by Chamberlin and Salisbury. Some of the old and crude woodcuts that have done service in the literature for over half a century might be honorably retired; for example, Figs. 79, 128, 311, 593.

The publisher's part has been well done. More care in the matter of ink and press-work might improve the quality of the half-tones, some of which are poor.

In the order of topics the author does not follow the usual practise of beginning with description of geologic processes open to observation, surficial geology, but uses the philosophical or deductive order of cause and effect. Three short chapters on the nature and scope of the science are succeeded by chapters on the materials composing the earth's crust, mineralogic and chemic geology, and volcanism. This is discussed in the interesting preface.

The many subjects in dynamic and structural geology are covered in the remaining 14 chapters of Part I.; the author's more original matter being on saline deposits (Chapter 11); organic deposits (Chapters 12, 13); and on the deposition, classification and structure of the clastic rocks (Chapters 16–18).

Historical Geology, Part II., does not offer much opportunity for any original treatment. The life history of the past is well emphasized.

The author is strong on classification and terminology, and in consequence of his refined classification some topics are subdivided and treated under different heads. For example, glaciers are discussed in at least four places in the first volume. The student who wishes to find what the book contains on a subject may have to consult the index many times.

A favorite subject of the author is the problems of sedimentation; marine transgression and regression, overlap and offlap, origin of saline deposits, etc. He discusses these in a masterly way. But he does not clearly distinguish between accepted fact and his own plausible philosophy. An elementary text-book in science should contain very little beyond established fact and generally accepted principles. In a comprehensive work like this, intended for advanced students, new theories and perhaps even subjects under sharp discussion may be admitted, but such should be distinctly stated as tentative. This matter needs to be specially guarded by an author who is active in scientific debate. It will be recognized as bad form for an author to use a text-book for propaganda. Students should realize that scientific truth comes by observation and experiment, not by mere thinking. Theorizing is helpful as it points the way for induction. Grabau's discussion of sedimentation, especially as it relates to Paleozoic stratigraphy, will provoke debate and will be stimulating to advanced students.

The work makes very large use of foreign material and of illustrations from foreign literature. Indeed, on many topics the description of foreign features and phenomena is in excess. The work should be a satisfactory text for European students. But American students will be disappointed in the meager discussion and illustration of some interesting features of American geology. Some topics having very inadequate treatment, as noted in the rapid review, are: American geysers with only a few words, but four pages, including four cuts, of geysers in general; two pages on petroleum and rock gas; the glacial lakes and tilted shorelines in the basin of the Great Lakes and the Hudson-Champlain valley receive only a few lines (page 695); only three pages on coal; only four lines to drumlins.

What may be regarded as a defect in the work is the entire absence of references to the geologic literature. Some reference to the more important articles on topics only briefly discussed in the work would be very useful to the reader. And for subjects on which other authorities may differ references to the literature are necessary for impartial study.

The work is too full and too large to be used as a text for beginners. The author evidently had laboratory use in mind. Only the test of actual use can prove its value in competition with other excellent works. The time has passed when all of geologic general science, even for our continent, can be usefully gathered into one or two volumes. That was fairly done by Dana, fifty years ago. Fifteen years ago Chamberlin & Salisbury had to make three

volumes. A present-day book for beginners should contain little more than the basal principles and the more striking and interesting facts and illustrations. For advanced work special treatises on separate branches of the science are desirable. Already the economic or industrial geology has been divorced from general study. The same is true for earth forms or physiography; and partially for paleontology. Further differentiation may cover dynamics and geophysics; surficial processes; sedimentation and structure; meteorologic and glacial geology; with perhaps later division of the historical.

Grabau is now in China, as professor of paleontology in the University of Peking, and Paleontologist to the Chinese Geological Survey, and we may anticipate further enrichment of geologic literature from his prolific and facile pen.

H. L. FAIRCHILD

SPECIAL ARTICLES

A PRECISION DETERMINATION OF THE DIMENSIONS OF THE UNIT CRYSTAL OF ROCK SALT

ALL measurements of X-ray wave-lengths and of crystal structures depend upon the solution of the atomic marshalling of some crystal and a calculation of the dimensions of the fundamental unit of that crystal in terms of its mass and density. The crystal most used in this connection is rock salt (NaCl). It is the purpose of this note to give the side of the unit cube of NaCl in terms of the most accurate data available.

The NaCl crystal was early shown by Bragg to be a cube, alternate corners of which are occupied by Na, the remaining corners being occupied by Cl. Since one half of one Na and one half of one Cl are each associated with one unit cube, the mass of the unit must be

$$1/2\,[A_{Na} + A_{Cl}]\,m,$$

where A_{Na} is the atomic weight of Na,
A_{Cl} is the atomic weight of Cl,
m is the mass in grams associated with one unit of atomic weight.

The 1919 International Table of Atomic Weights gives

$$A_{Na} = 23.00$$
$$A_{Cl} = 35.46$$

If these values should be wrong by .01 the error would be less than .05 per cent. in each case.

m is most easily found as e/F where e is the charge on the electron, F is the Faraday constant in electrolysis. Millikan[1] gives e as 4.774×10^{-10} Abs. E. S. units of charge with a maximum error of .1 per cent.

This gives $e = \log^{-1} \bar{1}9.20176$
$= 1.591 \times 10^{-19}$ absolute coulombs.

Vinal and Bates,[2] of the Bureau of Standards give

F (Iodine) = 96,515
(Silver) = 96,494
Mean = 96,505 international coulombs.

They have determined the absolute coulomb as being .004 per cent. greater than the international coulomb, and recommend the value in absolute coulombs,

$$F = 96{,}500$$

The maximum error is .01 per cent.

From the above

$$m = e/F = \log^{-1} \bar{2}4.21723$$
$$= 1.649 \times 10^{-24} \text{ gms.}$$

The density of NaCl is given by Zehnder (1886) as 2.188, by Retgers (1890) as 1.167, by Krickmeyer (1896) as 2.174 and by Gossner (1904) as 2.173. Gossner's work[3] seems to have been done with special care. He measured eleven artificial crystals of NaCl, obtaining densities ranging from 2.171 to 2.175. His measurements on natural crystals gave 2.173. Taking these results in connection with those of Krickmeyer, we may assign to NaCl a density of $2.173 \pm .002$, thus giving a maximum

[1] R. A. Millikan, "A new determination of *E*, *N*, and related constants," *Phil. Mag.*, *34*, 1917.

[2] G. W. Vinal and S. J. Bates, "Comparison of the silver and iodine voltameters, and the determination of the value of the Faraday," *Bull. Bureau of Standards*, *10*, 425, 1914.

[3] B. Gossner, "Untersuchung polymorpher Körper," *Zeit. f. Kryst.*, *38*, 132, 1904

error of .1 per cent. It should be understood that this density refers to measurements at room temperature. The coefficient of expansion of NaCl is given by the Smithsonian Tables as $.40 \times 10^{-4}$, so that a variation of 10° C. in either direction from normal room temperature would make an error of less than .05 per cent. in the side of the cube.

The volume of the unit cube of NaCl is therefore

$$V = \frac{\text{Mass}}{\text{Density}} = \log^{-1} \bar{23}.34600$$
$$= 22.182 \times 10^{-24} \text{ cc.}$$

and the side of the unit cube is

$$d = \log^{-1} \bar{8}.44867$$
$$= 2.810 \times 10^{-8} \text{ cm.}$$

Even if all the values entering into this result were in error to the maximum amount, and all in such a direction as to affect the final result in the same sense, the change in the value of d would be less than .1 per cent.

For purposes of reference, the table below gives the logarithms of the interplanar distances of a simple cube of side $\log^{-1} .44867$ and the actual distances to three decimal places. These lines are all found in the powder diffraction pattern of NaCl. The additional lines of the face-centered cube of Cl ions ($d = 5.620$) are not included in the table as they are too faint to measure easily on a film and are therefore useless for calibration purposes.

Plane	Log Distance	Distance
100	.44867	2.810
110	.29816	1.987
111	.21011	1.622
100 (2)	.14764	1.405
210	.09919	1.257
211	.05960	1.147
110 (2)	$\bar{1}$.99713	.993
211 100 (3)	$\bar{1}$.97115	.936
310	1.94867	.889
311	$\bar{1}$.92798	.847
111 (2)	$\bar{1}$.90908	.811
320	$\bar{1}$.89170	.779
321	$\bar{1}$.87561	.751
100 (4)	1.84661	.702
410 322	$\bar{1}$.83345	.681
411 110 (3)	$\bar{1}$.82104	.662
331	$\bar{1}$.80930	.645
210 (2)	$\bar{1}$.79816	.628
421	$\bar{1}$.78756	.613
332	$\bar{1}$.77746	.599
211 (2)	$\bar{1}$.75857	.574
430 100 (5)	$\bar{1}$.74970	.562

Wheeler P. Davey
General Electric Company,
Schenectady, N. Y.

THE AMERICAN ELECTROCHEMICAL SOCIETY

SOCIAL EVENTS, LECTURES

It was generally conceded by all in attendance at Lake Placid that a most unique meeting place had been selected for a Fall meeting. Through the courtesy of the Lake Placid Club their recreation facilities were placed at the disposal of our members and afforded excellent opportunities for taking part in golf, tennis, motoring and mountain hiking.

A great deal of the success of the meeting is due to Mr. W. M. Corse, who spared no effort as acting chairman of the arrangements committee.

On Thursday, September 29, at 9 A.M., the fortieth General Meeting of the Society was called to order by President Acheson Smith, who then introduced Dr. Melvil Dewey, founder and president of the Lake Placid Club. Dr. Dewey cordially welcomed our members and mentioned several points of interest that everyone should see while at Lake Placid. The reading and active discussion of papers followed this talk and were continued in the mornings of the next two days, the features of which were respectively the symposiums on Non-ferrous Metallurgy and Electrodeposition.

The boat ride, on Thursday afternoon, comprising a round trip on Lake Placid, was enjoyed by each of the 48 persons on board.

A brief history of the Lake Placid Club was outlined by Dr. Dewey in a short talk preceding the lecture on "Chemistry and the Stars" by Professor Harlow Shapley. With the aid of lantern slides Professor Shapley presented a very interesting account of the stellar universe and of the work being done at the Mt. Wilson Observatory.

Friday afternoon. A mountain hike up Mt. MacIntyre was a thrilling experience for all in the party. The club lodge at the base of this peak was reached by motor car through 10 miles of winding roads. An unusual rain storm prevailed before the party had reached the halfway mark, but this was

no obstacle in the way of seven or eight who finally succeeded in reaching the summit.

On Friday evening Dr. Dewey gave a number of illustrations on "How English can be made the world language by removing the chief obstacle in learning it." This talk was followed by an illustrated lecture on "The practise of forestry on national forests," by Col. T. S. Woolsey. Col. Woolsey has been connected with U. S. Forest Service and his various slides were very interesting.

Mr. Arthur Delroy very cleverly explained how character is read from hands and handwriting, and gave illustrations of how the "impossible" or magic trick was performed on the stage.

Later in the evening an informal dance closed the social events of the meeting.

TECHNICAL SESSIONS

Each of the three technical sessions was attended by a number of members and guests who took active part in discussing the papers presented. The result was that the proceedings, carried out according to schedule, were lively as well as interesting.

The Thursday morning session was filled by reading and discussion of papers:

Experiences with alkaline and alkaline earth metals in connection with non-ferrous alloys: CHARLES VICKERS. Sodium appears to have a negative value for copper, but seems to be superior to phosphorus in deoxidizing bronze. Calcium, of the alkaline earth metals, appears valueless in producing sound copper castings. As a deoxidizer, calcium is best adaptable when combined with an acid element, as silicon, and is further improved when combined with a third element.

The electrolytically produced calcium-barium-lead alloys comprising Frary metal: W. A. COWAN, L. D. SIMPKINS and G. O. HIERS. This paper presented by Mr. Hiers described the development of Frary Metal and its production by electrodeposition from a mixture of calcium and barium chlorides over a bath of molten lead as cathode. The properties of Frary metal are compared with those of other bearing metals. As a bearing metal it has desirable hardness and strength at elevated temperatures.

The electrolytic corrosion of lead-thallium alloys: COLIN G. FINK and C. H. ELDRIDGE. Presented by DR. FINK. Anodic corrosion losses in an acid copper sulfate electrolyte containing nitric and hydrochloric acids are reduced by using lead-thallium alloys. A minimum loss of 1.2 lb. per 100 lb. of copper deposited resulted with a lead anode containing 10 per cent. Tl and 20 per cent. Sn.

A new theory of the corrosion of iron: J. NEWTON FRIEND. An auto-colloidal catalytic theory, which postulates the corrosion as starting by the formation of colloidal ferrous hydroxide. This by contact with the air forms hydrated ferric hydroxide which in turn is alternately reduced by contact with iron and oxidized by contact with air, thus continuing the corrosion.

Rust prevention by slushing: HAAKON STYRI. An extended research which shows that for protection against rust by greases a thorough cleaning of the steel parts by an aqueous solution is essential; an oil emulsion which leaves an oil film for short time protection is preferable. Such emulsions protect against rust.

Transformer oil sludge: C. J. RODMAN. Of the three types of transformer oil sludge (asphaltic, soap and carbon), the asphaltic is the most general form and is the oxidation product of an attackable oil. It collects upon the active parts of transformer. The soap sludge forms slowly and is difficult to remove by filtration. The carbon sludge is caused by electrical breakdown.

The electrolysis of organic compounds: RAYMOND FREAS. The author endeavors to encourage further research of organic compound electrolysis. The discussion, limited to electro-reduction processes, presents the factors influencing the relative velocities of reaction, and despite their great number it is maintained possible to secure selective reduction electrolytically. A convenient experimental arrangement is described.

Electrolytic oxidation of the leuco-base of malachite green: ALEX. LOWY and E. H. HAUX. That the dye stuff malachite green can be produced by electrolytic oxidation of the leuco-base is set forth in a series of experiments. The highest dye yield resulted with uranyl sulphate as catalyst, platinum cathode, and nichrome gauze anode in dilute sulphuric acid solution, at 85° C.

The electrolytic dissociation of cyanamide and some of its salts in aqueous solution: N. KAMEYAMA. The degree of dissociation and of hydrolysis of sodium and calcium cyanamide was determined; from this the dissociation constant was calculated and the mobility of the cyanamide anion estimated.

Electrolytic production of sodium perborate: P. C. ALSGAARD. After presenting a detailed account of the work by Arndt and by Valeur, the author relates the results of his experiments and their application to larger scale production.

The electrolytic oxidation of hydrochloric acid to perchloric acid: H. M. Goodwin and E. C. Walker. The investigation and data present the effect of acid concentration, current density, duration of electrolysis and temperature on the yield of perchloric acid. A cell yielding 800 grams of 60 per cent. acid per 24 hours is described.

Graphic control of electrolytic processes: B. G. Worth. A graphic method of maintaining fixed conditions in potassium chlorate production is presented. Of the three factors which influence the yield, two represent concentrations of 2 compounds one of which is controllable by addition agents, and the third is temperature.

Friday morning was devoted to a Symposium on Non-ferrous Metallurgy. The papers included were:

The influence of the electric furnace on the metallurgy of non-ferrous metals: H. M. St. John. The use of the electric furnace in brass foundries and refining plants for melting purposes has revolutionized metal handling methods; a more uniform quality of product is obtained with less labor and less metal wastage. The attainments are better than have been previously possible and the secretiveness which has been characteristic of the non-ferrous industry is gradually being done away with.

Modern developments in the British brass industry: E. A. Smith. The actual condition of the British brass industry is presented with a discussion of electric brass furnaces, hot pressing and forging in brass, rolling mill practice, annealing, etc.

Resistance type of electric furnace in the melting of brass and other non-ferrous metals: T. F. Baily. The various features to be considered in making an electric furnace installation for melting non-ferrous metals are discussed.

Comparison of electric furnace practise with fuel-fired furnace practise: N. K. B. Patch. The author's experiences are that the cost of metal melted, the melting losses, and the solution of gases in metal, are substantially the same in the electric and the fuel-fired furnace, providing intelligent operation is pursued.

Electric silver melting: H. A. DeFries. Describes advantages of electric furnace melting of silver and relates how a more ductile and tougher silver results upon introducing an iron block into the bath.

Electric furnace melting of nickel-silver: F. C. Thompson. Advantages of melting nickel-silver in the externally heated electric furnace are discussed.

Aluminum-copper alloys: R. J. Anderson. A discussion of the manufacture, properties and uses of the commercial aluminum-copper alloys employed in the United States.

Recent developments in electric furnaces of the muffled arc type: H. A. Winne. Several types of muffled arc melting furnaces are described with their features and adaptabilities.

Electric furnace purification of zirkite: J. G. Thompson. The arc type furnace used in this investigation made it possible to remove 90–95 per cent. Si as an impurity from the zirkite ore; the amount of carbon introduced being only sufficient to transform the silicon to the carbide.

Physical characteristics of specialized refractories. Cross breaking strength at 20° and 1350° C.: M. L. Hartman and W. A. Koehler. The tests were carried out on each of ten refractory materials at the temperatures indicated.

An Electrodeposition Symposium was the feature of the morning of the closing day of the meeting, Saturday, October 1. The papers discussed were:

An electric steam-generator for low voltage: F. A. Lidbury and F. A. Stamps. An inexpensive form of apparatus for the generation of steam by means of an alternating current of voltages from 100 to 500.

The effect of pressure on overvoltage: H. M. Goodwin and L. A. Wilson. The values of overvoltage of hydrogen against copper, nickel and mercury electrodes were determined at pressures varying from one atmosphere to a few centimeters of mercury.

Researches on the electrodeposition of iron: W. E. Hughes. The results of several experiments and those obtained by the author are related in the electrodeposition of iron from (1) sulphate solutions, (2) chloride solutions and (3) sulphate-chloride solutions.

Electrolytic solution and deposition of copper: T. R. Briggs.

Electrometallurgy of zinc: W. R. Ingalls. The developments in the electrolytic zinc extraction process and the progress, in Scandinavia, of electrothermic smelting are set forth.

Deposition of zinc from the zinc cyanide solution: C. J. Wernlund. This research was carried out with the intention of obtaining a zinc cyanide plating solution which would operate successfully under the most trying commercial conditions.

The electrodeposition of lead-tin alloys: Wm. Blum and H. E. Haring. That a finer grained de-

posit of alloys of lead and tin can be obtained from fluoborate solutions than is possible when depositing either of the metals under similar conditions is established.

The structure and properties of alternately electro-deposited metals: WM. BLUM. If during the deposition of copper thin layers of nickel are interposed, a deposit of greater tensile strength than pure copper results due to the restraining influence nickel has on the growth of copper crystals.

In all the meeting proved to be most profitable, social and instructive.

A. D. SPILLMAN,
Secretary

THE OPTICAL SOCIETY OF AMERICA

HELMHOLTZ MEMORIAL MEETING

THE sixth meeting of the Optical Society of America was held in Rochester, N. Y., October 24, 25, 26, 1921. 113 persons were registered in attendance. The attendance at various sessions varied from about 35 to 100 or more.

The most notable feature of the meeting was the Helmholtz Memorial Meeting held on the afternoon and evening of Monday, October 24. The following former students of Helmholtz were present: Professor Henry Crew, Professor C. R. Mann, Professor Ernest Merritt, Professor E. L. Nichols, Professor M. I. Pupin, Dr. Ludwik Silberstein. The afternoon program was as follows:

A brief survey of the historical development of optical science: PROFESSOR J. P. C. SOUTHALL.

Helmholtz's early work in physics—the conservation of energy: PROFESSOR HENRY CREW.

Helmholtz's contributions to physiological optics: L. T. TROLAND.

Professor Crew exhibited lantern slides showing Helmholtz at the time he wrote the essay on the Conservation of Energy (age 26) and also at later periods of his life.

At the evening session Professor M. I. Pupin spoke informally and in most interesting and delightful manner on his Personal Recollections of Helmholtz. Professor E. L. Nichols, Professor Ernest Merritt, Dr. Ludwik Silberstein, Mrs. Christine Ladd-Franklin and Professor C. R. Mann also spoke of their memories of Helmholtz as a teacher. Professor Mann showed a lantern slide of a photograph which he himself made on July 7, 1894, showing Helmholtz at his lecture desk only a few days before his last illness.

The Helmholtz Memorial addresses will be published in the Journal of the Optical Society of America.

Various scientific societies were represented at the meeting by delegates as follows:

American Mathematical Society: Professor A. S. Gale.

American Physical Society: Professor M. I. Pupin, Dr. L. T. Troland, Professor Henry Crew.

American Association for the Advancement of Science: Professor M. I. Pupin.

New York Academy of Science: Professor M. I. Pupin.

American Academy of Ophthalmology and Oto-Laryngology: Dr. R. S. Lamb.

American Medical Association, Section of Ophthalmology: Dr. W. B. Lancaster.

American Ophthalmological Society: Dr. Lucien Howe, Dr. George S. Crampton.

Society of Illuminating Engineers: Dr. George S. Crampton.

American Psychological Association: Dr. L. T. Troland, Mr. Prentice Reeves, Professor C. E. Ferree, Dr. P. W. Cobb.

The following papers were presented at the regular sessions of the Society on October 25 and 26.

Photo-electric potentials from the retina: E. L. CHAFFEE AND W. T. BOVIE (to be published in full in the *Jour. Op. Soc. Am.*).

Intensity and composition of light and size of visual angle in relation to important ocular functions: C. E. FERREE AND GERTRUDE RAND.

A theory of intermittent vision: HERBERT E. IVES (to be published in full in the *Phil. Mag.*).

An analysis of the visibility curve in terms of the Weber-Fechner law and the least perceptible brightness: ENOCH KARRER (to be published in full in the *Jour. Op. Soc. Am.*).

A quantitative determination of the inherent saturation of spectral colors: L. T. TROLAND (to be published in full in the *Jour. Op. Soc. Am.*).

The interrelations of brilliance and chroma studied by a flicker technique: L. T. TROLAND AND C. H. LANGFORD (to be published in full in the *Jour. Op. Soc. Am.*).

A proposed standard method of colorimetry: HER-

BERT E. IVES (to be published in full in the *Jour. Op. Soc. Am.*).

Accuracy in color matching: W. E. FORSYTHE (to be published in full in the *Jour. Op. Soc. Am.*).

Measurement of the color temperature of the more efficient artificial light sources by the method of rotatory dispersion: IRWIN G. PRIEST (to be published in full in the *Jour. Op. Soc. Am.*).

The Blue Glow: E. L. NICHOLS AND H. L. HOWES (to be published in full in the *Jour. Op. Soc. Am.*).

The optical properties of a cylindrical enclosure with specularly reflecting walls: HERBERT E. IVES.

The relation between glass and the deflection characteristics of surfaces: LLOYD A. JONES AND M. F. FILLIUS (to be published in full in the *Jour. Op. Soc. Am.*).

The graininess of photographic materials: LLOYD A. JONES AND ARTHUR C. HARDY (to be published in full in the *Jour. Frank. Inst.*).

The design of aspherical lens surfaces: P. G. NUTTING.

On the distribution of light in planes above and below the image plane in the microscope: FRED E. WRIGHT.

The factors underlying the measurement of refractive indices by the immersion method: FRED E. WRIGHT (two preceding to be published in one paper in the *Jour. Op. Soc. Am.*).

Some thermal effects observed in chilled glass: A. Q. TOOL AND C. G. EICHLIN.

A new X-Ray diffraction apparatus: WHEELER P. DAVEY (to be published in full in the *Jour. Op. Soc. Am.*).

Rotating photometric sectors of adjustable transmission while in motion: CARL W. KEUFFEL AND C. D. HILLMAN (to be published in full in the *Jour. Op. Soc. Am.*).

Euscope: WILLIAM G. EXTON.

Turbibimeter: WILLIAM G. EXTON.

On Tuesday evening, October 25, visiting members were guests at a dinner entertainment given by the Rochester Section of the Society.

The very well conducted trips through the Research Laboratories of the Eastman Kodak Company and the glass plant, optical shops and observatory of Bausch and Lomb were also much appreciated by the visiting members.

The Rochester Section was given a hearty vote of thanks for its hospitality and the many courtesies extended during this very successful meeting.

Forty new members were elected. The membership is now about three hundred.

The Society's intention to cultivate actively the field of physiological optics was indicated by the following resolution, adopted October 26, 1921:

WHEREAS the Optical Society of America is devoted to the science of optics, pure and applied, a subdivision of which is the subject of Physiological Optics, with the several contributory sciences of physiology, psychology, physics and chemistry, representatives of which sciences have at the present time no common meeting ground for the discussion of problems of vision of mutual interest and

WHEREAS, the National Research Council, through its Committee on Physiological Optics, has recommended to the Optical Society of America the taking of such steps as may be necessary to further and encourage cooperative efforts in research in vision and allied phenomena, therefore be it

Resolved that the Optical Society of America does hereby signify its intention of devoting one or more sessions of each annual meeting to papers on Physiological Optics and other appropriate subjects related to vision, and

Resolved that there be and hereby is established by the Society a Standing Committee of three, the duty of which shall be

(1) To prepare the program of the sessions on Vision,

(2) To coordinate the work of the Society in this field with the work of other Societies and

(3) To recommend, from time to time, such further steps as may be deemed effective in encouraging research in Physiological Optics and allied problems. And

Resolved further that the Optical Society, through its Committee on Physiological Optics, shall invite all those interested in research on Vision and allied fields to participate actively in these sessions.

The next meeting will be held at the National Bureau of Standards in Washington in the latter part of October, 1922. It is tentatively planned to hold an exhibition of optical instruments in connection with this meeting.

IRWIN G. PRIEST,
Secretary